Helium-Oxygen Blender

Service Manual

Model No. PM5400 Series
PM5500 Series (shown)

SAVE THESE INSTRUCTIONS

PRECISION MEDICAL

300 Held Drive
Northampton, PA 18067 USA

Tel: (+001) 610-262-6090
Fax: (+001) 610-262-6080

www.precisionmedical.com

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SECTION 1: SAFETY INFORMATION - WARNINGS AND CAUTIONS

WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

WARNING

- Disconnect the Heliox-Oxygen Blender from all connections prior to disassembly.
- Use Medical Heliox and Medical Oxygen when servicing to avoid contamination.
- The Heliox-Oxygen Blender should be serviced by a qualified service technician.
- An Oxygen Analyzer/Monitor must be used to verify Oxygen concentrations.
- When reassembling the Blender, do not pressurize the system until the retaining screw of the Proportioning Module has been fully tightened. **The Proportioning Module can be forcefully ejected by gas pressure if not sufficiently tightened.**
- Always follow ANSI and CGA standards for Medical Gas Products, Flowmeters and Oxygen Handling.
- When servicing requirements of Directive 93/42/EEC concerning medical devices and all International Standards apply. **(On CE marked devices ONLY)**
- **DO NOT** obstruct the alarm.
- **Oxygen Concentration Dial does not rotate 360 degrees.** Rotating the dial less than 21% or over 100% Oxygen will damage the Blender.

Service Warning

- This Service Manual is provided for your safety and to prevent damage to the Heliox-Oxygen Blender.
- It is essential to read and understand this entire manual before attempting to service the Heliox-Oxygen Blender.
- If you have any questions regarding the installation, setup, operation, and/or maintenance of the Heliox-Oxygen Blender, contact Precision Medical, Inc.

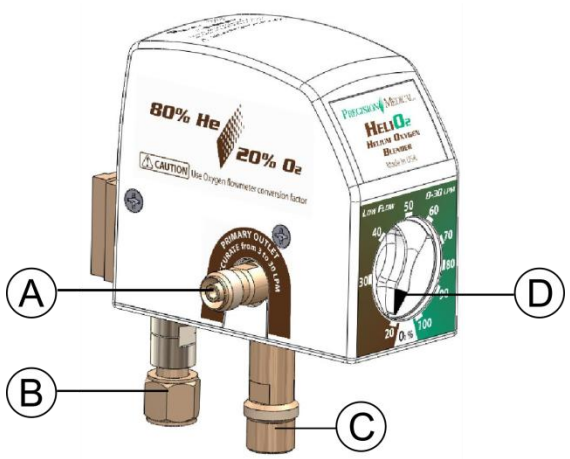
CAUTION

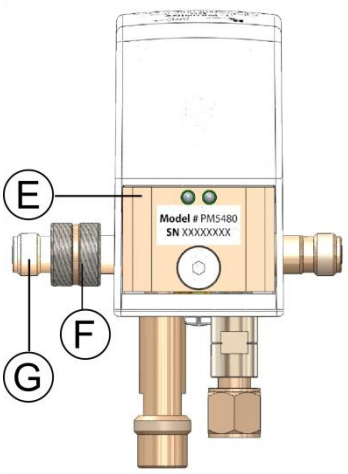
- Use recommended lubricants sparingly as lubricant may migrate to other areas and cause the Blender to malfunction.
- When pressurizing the Blender inlets, avoid pressure surges greater than 100 psi (6.9 bar) .
- Ensure all connections are tight and leak free before returning to service.
- Store Blender in a clean, dry area when not in use.
- **DO NOT** steam autoclave.
- **DO NOT** gas sterilize with (ETO) Ethylene Oxide.
- **DO NOT** immerse Heliox-Oxygen Blender into any liquid.
- **DO NOT** use if dirt or contaminants are present on or around the Blender or connecting devices.
- **DO NOT** clean with aromatic hydrocarbons.

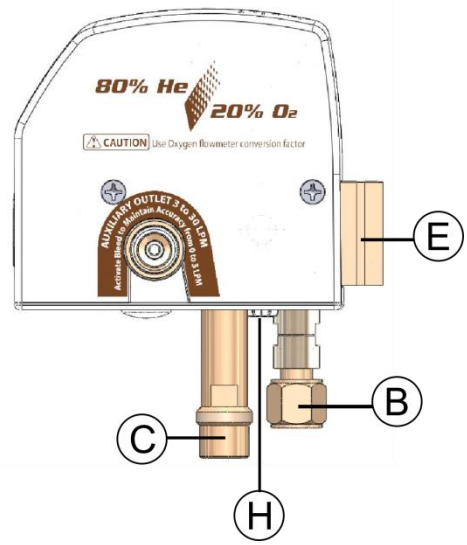
EXPLANATION OF ABBREVIATIONS

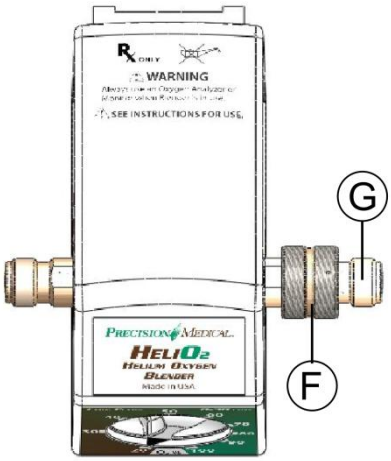
$FIHeO_2$	Fractional Concentration of Inspired Helium-Oxygen
FIO_2	Fractional Concentration of Inspired Oxygen
Heliox	Helium-Oxygen
DISS	Diameter Indexed Safety System
NIST	Non-Interchangeable Screw Thread
lpm	Liters Per Minute
psi	Pounds Per Square Inch
Nm	Newton meter

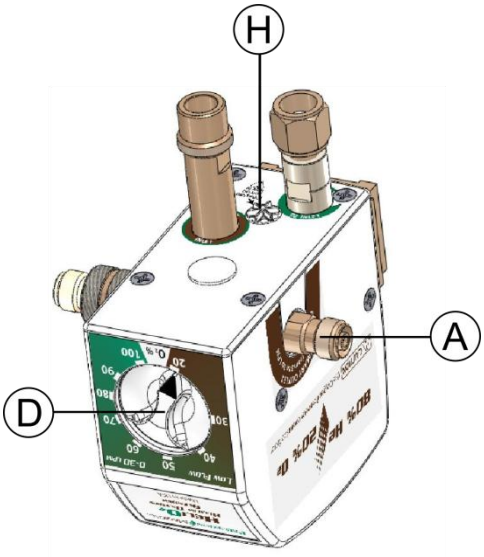
Blender Diagrams











Note: PM5480 Model Shown

ITEM	COMPONENT DESCRIPTIONS in Blender Diagrams
A	**Primary Outlet Port** A male DISS Oxygen fitting with check valve that delivers flow when engaged to any controlling device, such as a flowmeter.
B	**Oxygen Inlet Fitting** A female DISS or NIST Oxygen fitting with one way valve that is used to connect an Oxygen supply hose.
C	**Heliox Inlet Fitting** A male DISS or NIST Heliox fitting with one way valve that is used to connect a Heliox supply hose.
D	**Oxygen Concentration Dial** A dial used for selecting Oxygen concentrations between 20%-100% or 30%-100%. The FIO2 scale is used for reference only. **The actual FIO2 must be verified with an Oxygen Monitor.** **The Dial does not rotate 360°**. The dial starts at 20% or 30% and ends at 100%.
E	**Rear Slide Mount** with dove tail.
F	**Auxiliary Bleed Collar** The collar is used to engage and disengage the bleed. The bleed is necessary to maintain accurate F**IO2** Concentration below 15 lpm for the High Flow and 3 lpm for the Low Flow. To activate the bleed, slide and rotate (if applicable) the knurled collar back until it contacts the cover. To deactivate the bleed, pull and rotate (if applicable) collar away from cover until it reaches a positive stop.
G	**Auxiliary Outlet Port** A male DISS Oxygen fitting with check valve that delivers flow when engaged to any controlling device, such as a flowmeter. This outlet is equipped with a bleed valve that allows the user to control if the bleed is ON or OFF. With the bleed in the ON position, this outlet delivers accurate Oxygen concentrations in the following flows: **Model** — **Flow Range** High Flow — 2 – 100 lpm Low Flow — 0 – 30 lpm
H	**Alarm** An audible alarm that sounds due to an excessive pressure drop or deletion of either gas supply.

⚠ WARNING

- When pressurizing the Blender inlets avoid pressure surges greater than 100 psi (6.9bar).
- Always use a Heliox regulatorwhen using Heliox cylinders to supply gas to the Heliox inlet of the Blender.
- Always use an Oxygen regulator when using Oxygen cylinders to supply gas to the Oxygen Inlet of the Blender.

Example of set-up using a Heliox Cylinder

NOTE: Heliox regulator in use.

SECTION 2: TECHNICAL DESCRIPTION

The HELIO 2 Blender is a medical device used to mix Medical Heliox and USP Oxygen into a gas source ranging from 20-100% or 30-100% Oxygen. The inlet gas connections are standard DISS or NIST for each gas. The inlets are clearly marked and labeled on the bottom of the Blender. The outlets are standard DISS male Oxygen connections.

The front panel of the Blender has a dial that is used to set the specific FIO2 blend. The dial settings range from 20-100% on the PM5480 & PM5580 models and 30-100% on the PM5470 & PM5570 models.

The Path of the Gases

The supply enters through the Heliox and Oxygen inlet connectors located on the bottom of the Blender. Each inlet connector contains a particulate filter and duckbill check valves which prevent possible reverse gas flow.

Diaphragm Housing Module

The two gases then enter the two-stage pressure Diaphragm Housing Module. In this module, the pressures of both gas sources are equalized prior to entering the Proportioning Module. The pressure is equalized at the lower pressure. The diaphragm within the module responds to the difference in pressure and directs the movement of each check valve assembly contained within the Heliox and Oxygen chambers. The movement of each ball adjusts the amount of gas flowing through the Diaphragm Housing Module, equalizing the Heliox and Oxygen pressures to the lower pressure.

Proportioning Module

From the Diaphragm Housing Module the gases flow into the Proportioning Module and are mixed according to the Oxygen percentage selected on the Oxygen Concentration Dial. The Proportioning Module consists of a double ended valve positioned between two valve seats. One seat controls the passage of Heliox and the other valve seat controls the passage of Oxygen into the outlet. At this point, the two gases have been blended according to the Oxygen percentage selected on the Oxygen Concentration Dial.
With the Oxygen Concentration Dial at the full counterclockwise position (20/30%), the double ended valve will completely close off the flow of Oxygen, allowing only the Heliox to flow. By adjusting the Oxygen Concentration Dial to the full clockwise position (100%), the flow of Heliox is blocked, permitting only the flow of Oxygen through the Blender outlet.

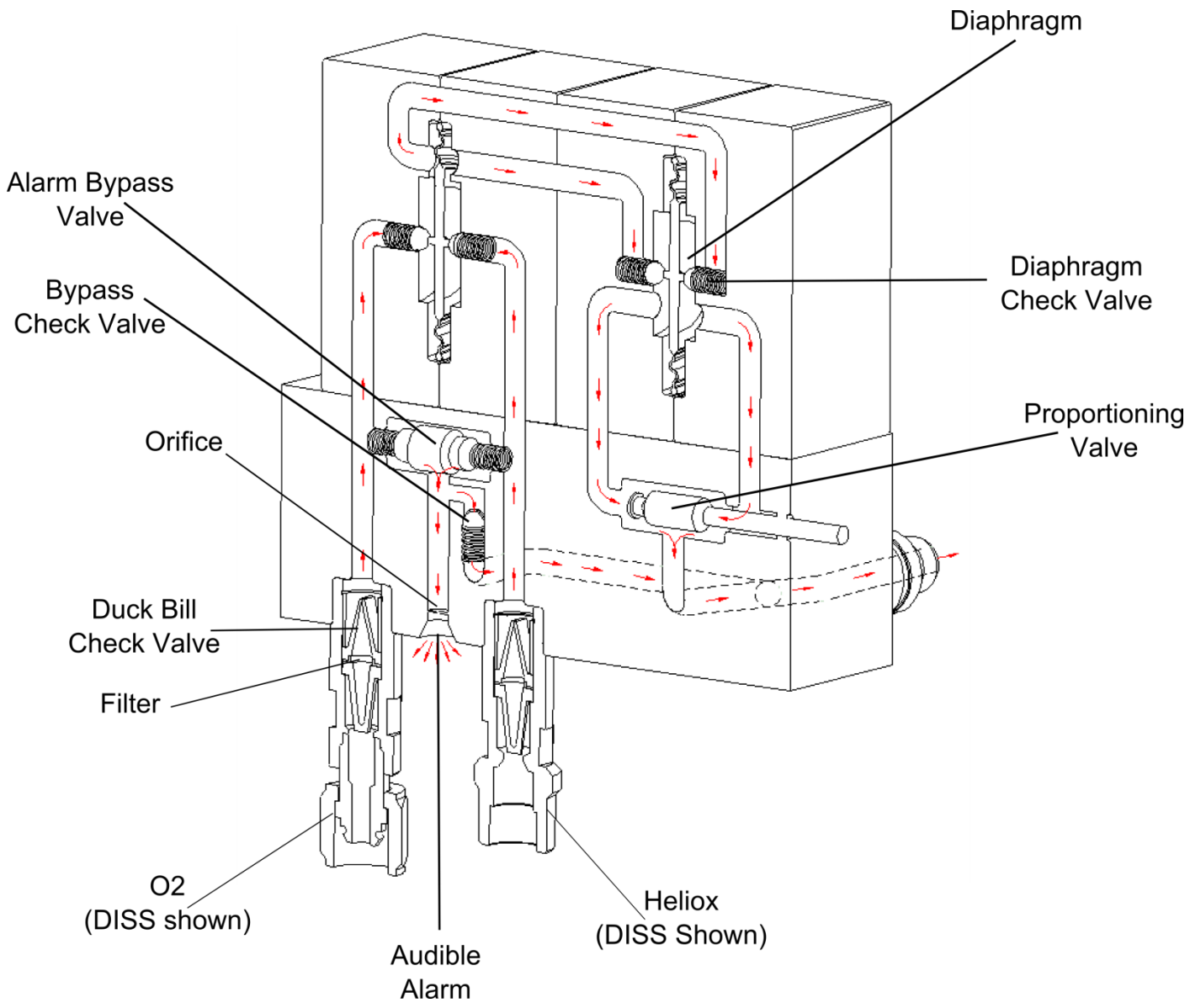
Alarm and Alarm Bypass

An audible alarm located on the bottom of the Blender signals when the difference in pressure between the two inlet gases is ≥ 18 psi for Low Flow and ≥ 13 psi for High Flow. When the source gases are near equal pressure, the alarm bypass poppet will remain seated over the alarm channel and the alarm does not sound. When the gas pressures become unbalanced the higher pressure gas will unseat the poppet by overcoming the spring force causing gas to flow through the alarm channel and the alarm sounds. The oxygen concentration from the Blender will be that of the higher gas pressure. The Blender in the alarm/bypass mode will deliver the oxygen (100%) or Heliox until the bypass mechanism resets when the source gas pressure is restored to a differential of approximately 6 psi (0.42 kg/cm2). If the Blender is set at 20 or 30% (depending on model), the OXYGEN source pressure is reduced or lost, the unit will not alarm because it will continue to deliver 20 or 30% concentration according to the setting. If the control is moved slightly from the 20 or 30% setting, the alarm will sound. Similarly, if the Blender is set to deliver 100% oxygen concentration and Heliox source pressure is reduced or lost, the unit will not alarm because it will continue to deliver the selected 100% concentration. **The alarm will not function when there is no flow to the blender.**

Gas Outlets

The Primary and Auxiliary Outlets are DISS male adapters with check valves.

HELIOX / OXYGEN FLOW PATH INDICATION DIAGRAM



SECTION 3: MAINTENANCE PROCEDURES, REPAIR AND CALIBRATION

I. LOW FLOW (PM5400 Model)

Step 1: DISASSEMBLY

Tools Required

#2 Phillips Screwdriver	11/32 in. Nut Driver
#3 Phillips Screwdriver	5/32 in. Long Hex Key
1/2 in. Open End Wrench	Small Retaining Ring Pliers

Figure A

1. Rotate dial [1] to the 60 graduation.
2. Remove the two flat head screws [2] on each side of the top cover [3].
3. Remove top cover by pulling upwards.
   The cover will not come off unless the dial is at the 60 graduation

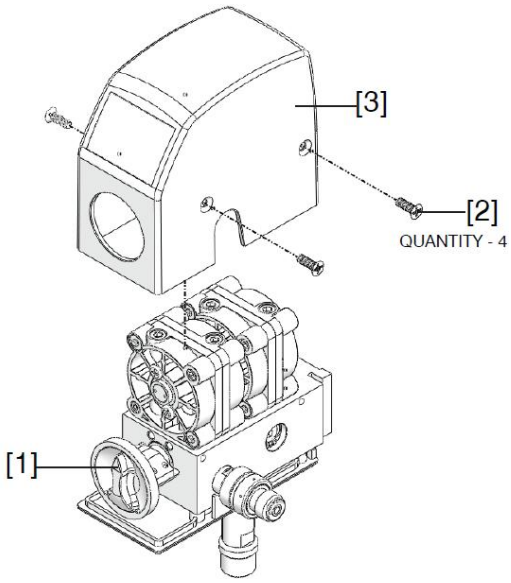


Figure B

4. Use a **½** in. open end wrench to unscrew and remove the Heliox [5] and Oxygen [4] inlet assemblies from bottom of the Blender.
   Oxygen inlet has left hand threads.
5. If manifold outlet assembly is present, unscrew the stem using a 5/32 hex key and holding the manifold outlet assembly to the bottom of the Blender.
6. Remove the four flat head screws [2] from bottom cover [6].
7. Remove bottom cover.

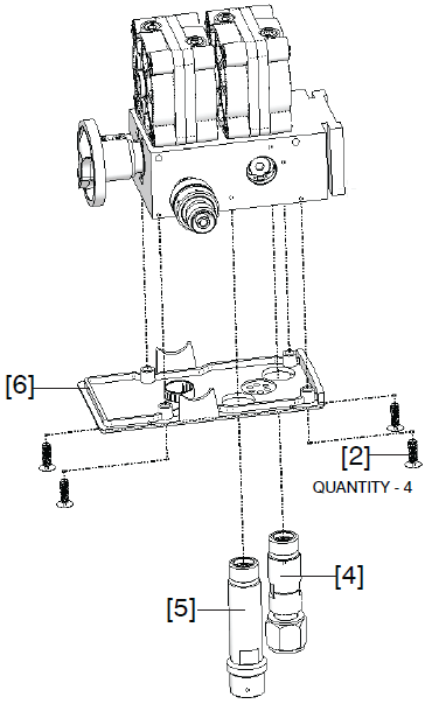


Figure C

8. Remove dial [1] by pulling dial away from manifold block [8].
9. Remove the primary [9] and auxiliary [10] outlets (auxiliary contains Blue Muffler [38]) by using a ½ in. open end wrench to unscrew.
10. Use Retaining Ring Pliers to unscrew and remove audio alarm assembly [11] from the bottom of the manifold block.

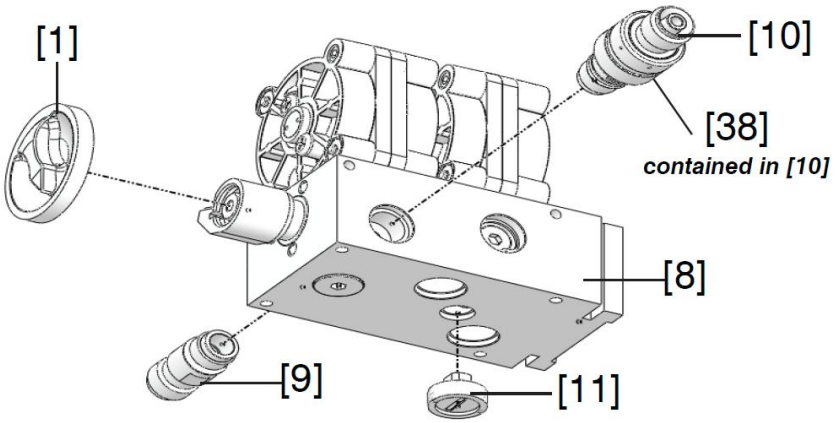


Figure D

11. Use small retaining ring pliers to remove retaining rings [12] from each side of the alarm assembly [13]. Push the alarm assembly through to remove the assembly from manifold block.

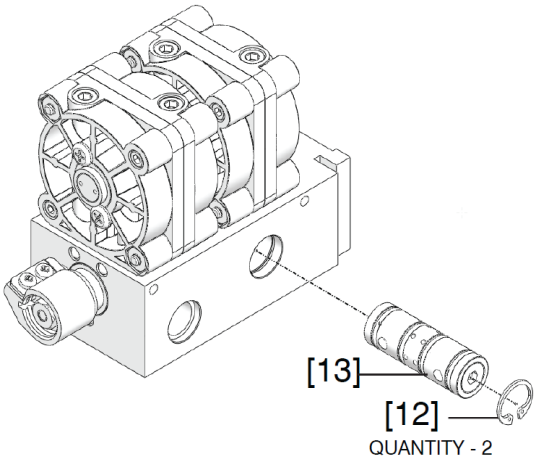


Figure E

12. Using a 11/32 in. nut driver or socket, loosen the nut [14] **(ONLY two turns)** holding the knob guide [15] on the proportioning valve assembly [16]. Slide knob guide assembly from proportioning valve assembly shaft. Slide resistance ring [17] from proportioning valve assembly.
13. Remove phillips head screw [18] and washer [19] from side of proportioning valve assembly.
14. Replace knob guide assembly and tighten the nut.
15. Pull knob guide assembly to remove proportioning valve assembly from manifold block. Again, loosen the nut **(ONLY two turns)** holding the knob guide to the proportioning valve assembly, remove knob guide from proportioning valve assembly shaft.

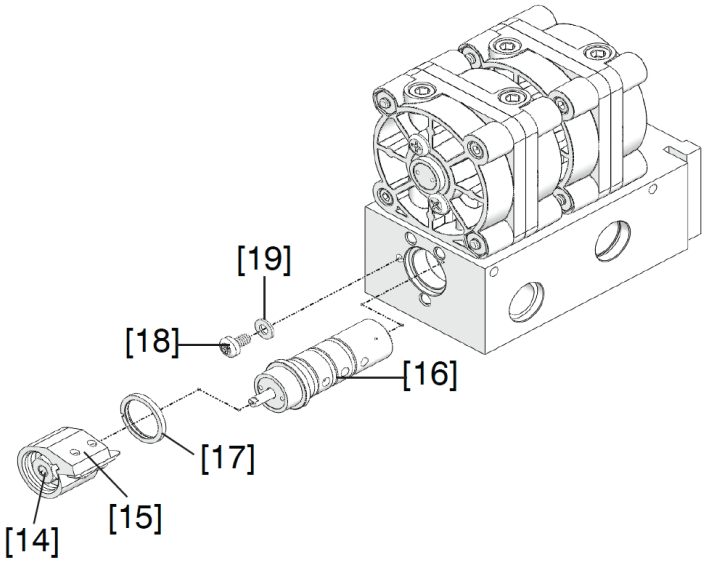


Figure F

16. Remove each diaphragm housing assembly [20] from the manifold by removing the two hex socket head screws [21] on the top of each diaphragm housing with 5/32 hex key.

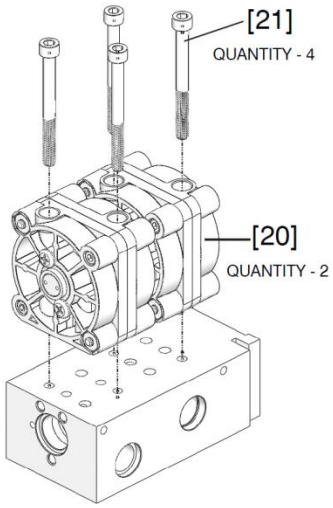
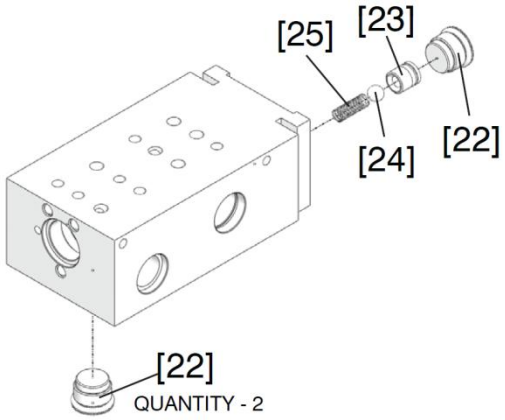


Figure G

17. Using 5/32 in. long hex wrench, unscrew and remove plug [22] from the bottom of the manifold block.
18. Remove rear plug [22] from the back of the manifold block. Insert a long 5/32 hex key through rear plug opening, unscrew and remove the alarm bypass body [23], ball [24] and spring [25].



Step 2: CLEANING

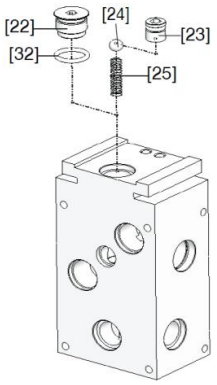
Precision Medical, Inc. recommends using an ultrasonic cleaner for cleaning all non-elastomeric and non-metallic components. However, cleaning with an all-purpose liquid cleaner and rinsing with clean, warm water may be substituted. Both methods require thoroughly blow drying all passages before reassembly. Follow the ultrasonic cleaner manufacturer instruction.

Step 3: LOW FLOW ASSEMBLY

Tools Required

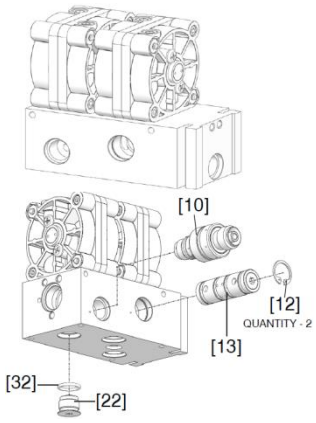
Lint Free Swab (optional)
Pointed instrument for removing O-rings
Krytox GPL 106 or equivalent
Oxygen safe lubricant
#2 Phillips Screwdriver
1/2 in. Open End Torque Wrench
(Torque wrench(s) capable of 60 in-lbs and 10 ft-lbs)
11/32 in. Nut Driver
5/32 in. Long Hex Key
Small Retaining Ring Pliers

Figure H



1. Position manifold block so that the mounting bracket is facing up. The large holes opposite the mounting locations of the diaphragm housing assemblies are facing you.
2. Cover the alarm assembly thread location with thumb. Drop spring [25] then ball [24] into alarm bypass orifice.
3. Place alarm bypass body [23] onto long shaft of 5/32 hex key. Guide the alarm bypass body, threads first into the alarm bypass orifice, and screw into cavity. Tighten until alarm bypass body is flush with bottom of center hole. **Tighten enough to clear center threads ONLY.**
4. Replace O-ring [32] on plug [22]. Insert plug and tighten.

Figure I



5. Lubricate alarm bypass assembly bore on manifold block with Krytox GPL 106.
6. Using retaining ring pliers install retaining ring [12] in one side of alarm assembly bore.
7. Insert alarm assembly [13] into bore of manifold block.
8. Install remaining retaining ring.
9. **For Models without manifold block assembly:**
   Replace O-ring [32] on plug [22] then install plug [22] into bottom hole of manifold block.
10. Thread auxiliary outlet assembly [10] to manifold block, torque to 10 ft-lbs (13.6 Nm).

LOW FLOW

Figure J

11. Thread new primary outlet assembly [37] to Manifold Block torque to 10 ft-lbs (13.6 Nm).

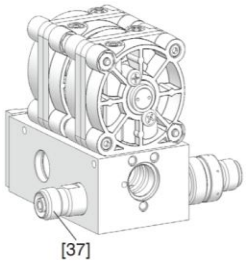
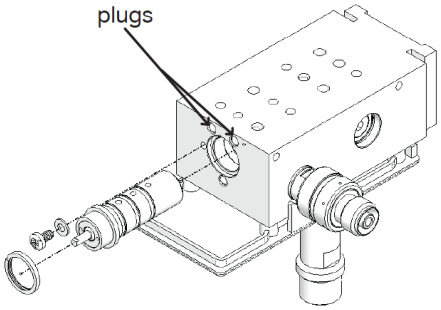


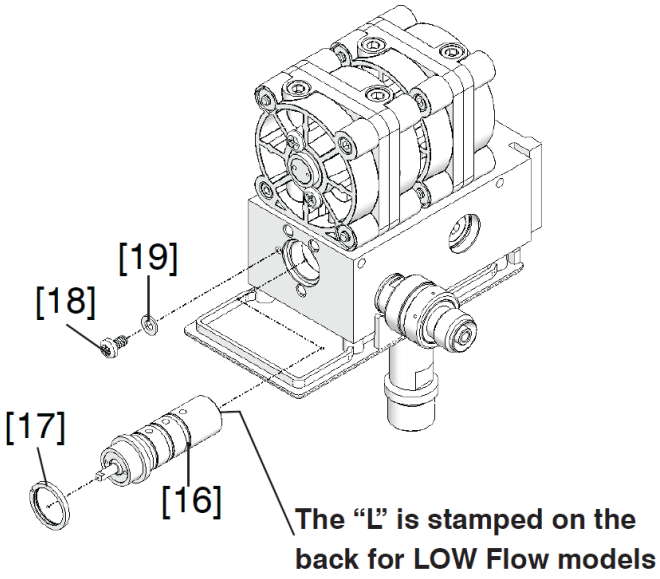
Figure K

12. Start threads of new alarm assembly [11] by hand, tighten with Retaining Ring Pliers, ensure not to bend reed.
13. Attach bottom cover [6] using four flat head screws [2].
14. Install new Oxygen inlet assembly [5] torque to 10 ft-lbs (13.6 Nm). **Oxygen inlet assembly has left handed threads.**
15. Install new Heliox inlet assembly [4], torque to 10 ft-lbs (13.6 Nm).

Figure L

16. Lubricate proportioning valve bore with Krytox GPL 106.
17. Align the (3) holes on the proportioning valve assembly [16] equal distance between the (2) plugs and push in. *Reference drawing below.
18. Replace washer [19] and phillips head screw [18].
19. Place new resistance ring [17] in its place on the proportioning valve assembly.
    ***Proportional valve assembly inserted, with the "L" stamped on back for Low Flow Model.**





Step 4: TEST

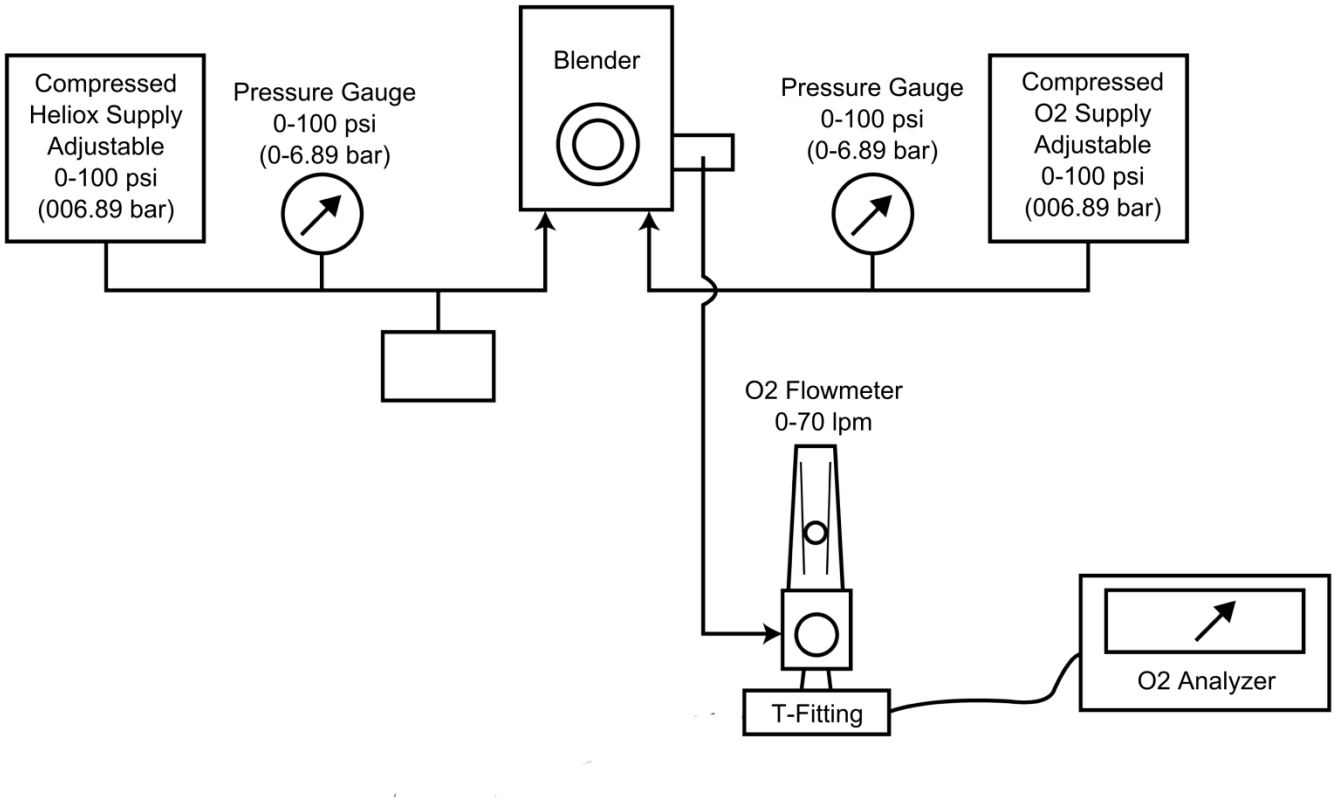
Equipment Required

Medical Heliox Supply
Medical Oxygen Supply
Calibrated Oxygen Analyzer/Monitor
Calibrated Heliox or Oxygen flow monitor 0 to 70 lpm or greater
Flowmeter 0 to 70 lpm or greater
Calibrated Pressure Gauges 0 to 100 psi
Regulators Tubing / Hoses

Tools Required

Phillips Screwdriver
Torque Driver capable of 10 in-lbs
Adjustable Wrench
Retaining Ring Pliers
Nut Driver

Typical Test Configuration Diagram


Compressed Heliox Supply Adjustable 0-100 psi (006.89 bar)
Pressure Gauge 0-100 psi (0-6.89 bar)
Blender
Pressure Gauge 0-100 psi (0-6.89 bar)
Compressed O2 Supply Adjustable 0-100 psi (006.89 bar)
O2 Flowmeter 0-70 lpm
T-Fitting
O2 Analyzer

Instructions for Testing

A. Heliox and Oxygen Supply Setup

Both gas supplies must be clean and dry per the specifications outlined in this manual and have the ability to generate up to 100 psi (6.89 bar) for both the Heliox and Oxygen inlet pressures. Verify Heliox and Oxygen supply concentrations with an analyzer/monitor.

B. Blender Setup

1. Mount the Blender into a secured mating wall or pole bracket in an upright position.
2. Secure the Heliox and Oxygen hoses to the corresponding Blender inlets.
3. It is recommended that a condensation trap be installed in the Heliox supply line just before the Blender Heliox inlet.
4. Attach a flowmeter capable of 0-70 lpm to the auxiliary outlet on the Blender.
5. Attach a t-fitting to the outlet of the flowmeter.
6. Attach an Oxygen Analyzer/Monitor to the one outlet on the t-fitting.
7. Attach a calibrated Heliox or Oxygen Flow Monitor capable of 0-70 lpm or greater to the other outlet on the t-fitting.
8. The system is now ready for an initial performance test.

C. Initial Performance Test

NOTE: Before pressurizing make sure proportioning valve assembly is secure and screw is tightened.

1. Perform calibration on Oxygen Analyzer/Monitor per the manufacturer's instructions prior to testing the Blender.
2. Set Heliox & Oxygen pressures to 50 psi (3.45 bar) each.
   NOTE: Turn OFF and check for leak by watching for pressure drops on pressure gauges.
3. An initial pressure drop may occur, no further drop in pressure should occur.
4. If continued pressure drop is observed, troubleshoot by using a commercial leak detector to find source of leak and refer to Section 4: TROUBLESHOOTING for further instructions.
5. Use a lint free dry cloth to wipe Blender clean of commercial leak detector.
6. Ensure both inlet pressures are at 50 psi.
7. Replace the top cover.
   NOTE: DO NOT install the (4) mounting screws until the end of the Final Test, or after satisfactory completion of the Performance Check. Refer to the "OPERATING INSTRUCTIONS" in Users Manual.
8. Set flowmeter to 3-3.5 lpm.
9. Set the Blender to 60% F_{IO_2} with Oxygen Analyzer/Monitor, this value should remain within 3.0% of original reading throughout the following test.
   a. Set flowmeter to 30-30.5 lpm, check concentration reading.
   b. Set flowmeter back to 3-3.5 lpm.
   c. Set Heliox inlet pressure to 50 psi (3.45 bar) and the Oxygen inlet pressure to 43 psi (2.96 bar) adjust flow to 3-3.5 lpm, check concentration reading.
   d. Set Heliox inlet pressure to 43 psi (2.96 bar) and the Oxygen inlet pressure to 50 psi (3.45 bar) adjust flow to 3-3.5 lpm, check concentration reading.
   e. If the Oxygen Analyzer/Monitor setting does not remain within 3.0% of the original reading, then replace one or both of the diaphragm block assemblies.

D. Reverse Gas Flow Procedure

(Reference Operational Verification Procedure #'s 2 & 3 in Table, page 15 or 25.)

1. Disconnect the Oxygen hose from the gas source. Remove all outlet connections from the Blender to ensure that there is no outlet flow.
2. Place the free end of the Oxygen supply hose under water. Gradually increase the Heliox supply pressure from 30 - 75 psi (2.07 - 5.17 bar), check for leakage past the Oxygen inlet check valve.
3. Replace the Duckbill Check Valve in the Oxygen inlet if bubbles indicate leakage.
4. Repeat steps 1-3 to check for leakage past the Heliox inlet check valve.
5. Reconnect the Heliox inlet hose and adjust both supply pressures back to standard inlet pressure.

E. Setup of PROPORTIONING VALVE ASSEMBLY CALIBRATION

1. Set Heliox and Oxygen inlet pressures to 50 psi.
2. Set flow to 9 lpm.
3. Turn Adjustment Shaft counterclockwise until the Oxygen Analyzer/Monitor displays a concentration equal to that of the source Heliox (±0.3), reference Part A in Setup.
4. Attach knob guide assembly onto adjustment shaft of proportioning valve assembly so that the knob stop rests on top of the screw. Ensure knob stop aligns with the slot in the resistance ring.
5. While applying downward pressure to the 2 screws on the knob guide assembly, attach nut to adjustment shaft using nut driver.
6. Turn knob guide fully clockwise, Oxygen Analyzer/Monitor display should be equal to concentration of the source Oxygen (±0.3).
7. Turn knob guide back to 21% position to ensure no drift from original reading (±0.3).
8. Re-attach knob guide, torque nut to adjustment shaft and tighten to 10 in-lbs using a torque driver.
9. Snap in knob back into knob guide, pay close attention to the key location of the knob.
10. Set knob to the 60 graduation.
11. Replace the top cover.
    NOTE: DO NOT install the four (4) mounting screws until the end of the Final Test.

F. Final Test

Complete Operation Verification Procedure as per the test table, page 15 or 25.
Record test results in the test table.
When Final Test is complete replace top cover and install the four (4) mounting screws into cover.
NOTE: Operation Verification Procedure should be performed at least once a year.

LOW Flow Operation Verification Procedure

USA and CANADA ONLY

(50 psi / 3.45 bar MODELS)

S E Q #	DIAL SET O2%	OXYGEN PRESS ±1.0		HELIOX PRESS ±1.0		FLOWMETER SET TO lpm ±0.2	AUXILIARY BLEED	FUNCTION	TARGET VALUE	ACTUAL VALUE
		psi	bar	psi	bar					
1	ANY	50	3.45	50	3.45	closed	closed	leak	<2 psi / 2 MIN	
*2	60	75	5.17	0	0	0	closed	back flow	<100 ml/min	
*3	60	0	0	75	5.17	0	closed	back flow	<100 ml/min	
4	21	50	3.45	50	3.45	3	open	end point	(±0.3) Source Value	
5	40	50	3.45	50	3.45	3	open	set point	37.0%-43.0%	
6	60	50	3.45	50	3.45	3	open	set point	57.0%-63.0%	
7	80	50	3.45	50	3.45	3	open	set point	77.0%-83.0%	
8	100	50	3.45	50	3.45	3	open	end point	(±0.3) Source Value	
9	60	50	3.45	50	3.45	1	open	set point	57.0%-63.0%	
10	60	60	4.14	67	4.62	1	open	set point	57.0%-63.0%	
11	60	60	4.14	50	3.45	1	open	set point	57.0%-63.0%	
12	60	50	3.45	Slowly reduce to 30	Slowly reduce to 2.07	3	closed	Alarm ON	30.0 ± 2.0 psi	
13	60	50	3.45	Slowly Increase until alarm shuts off		3	closed	Alarm OFF	45.0 psi MAX	
14	60	Slowly Reduce to 30	Slowly Reduce to 2.07	50	3.45	3	closed	Alarm ON	30.0 ± 2.0 psi	
15	60	Slowly Increase until alarm shuts off		50	3.45	3	closed	Alarm OFF	45.0 psi MAX	
16	60	50	3.45	50	3.45	MAX	closed	flow rate	30.0 lpm MIN	
17	60	50	3.45	0		MAX	closed	flow rate	30.0 lpm MIN	
18	60	0		50	3.45	MAX	closed	flow rate	30.0 lpm MIN	
19	60	50	3.45	50	3.45	MAX	open	flow rate	30.0 lpm MIN	

* Reference, Letter D. (Reverse Gas Flow Procedure)

II. HIGH FLOW (PM5500 Model)

Step 1: DISASSEMBLY

Tools Required

#2 Phillips Screwdriver	11/32 in. Nut Driver
#3 Phillips Screwdriver	5/32 in. Long Hex Key
1/2 in. Open End Wrench	Small Retaining Ring Pliers

Figure A

1. Rotate dial [1] to the 60 graduation.
2. Remove the two flat head screws [2] on each side of the top cover [3].
3. Remove top cover by pulling upwards.
   The cover will not come off unless the dial is at the 60 graduation

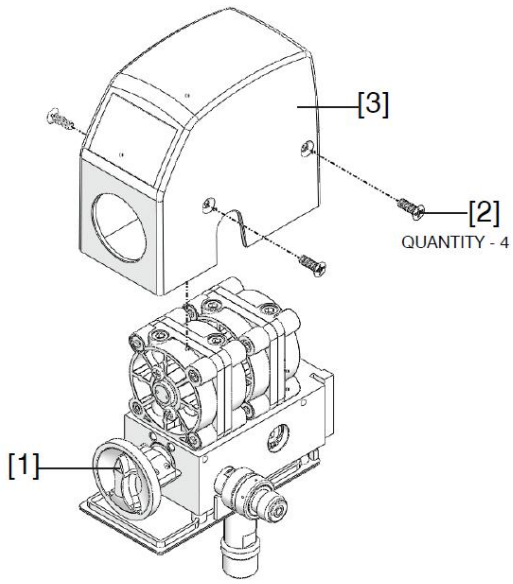


Figure B

4. Use a **½** in. open end wrench to unscrew and remove the Heliox [4] and Oxygen [5] inlet assemblies and primary [9] from bottom of the Blender.
   Oxygen inlet has left hand threads.
5. If manifold outlet assembly is present, unscrew the stem using a 5/32 hex key and holding the manifold outlet assembly to the bottom of the Blender.
6. Remove the four flat head screws [2] from bottom cover [6].
7. Remove bottom cover.

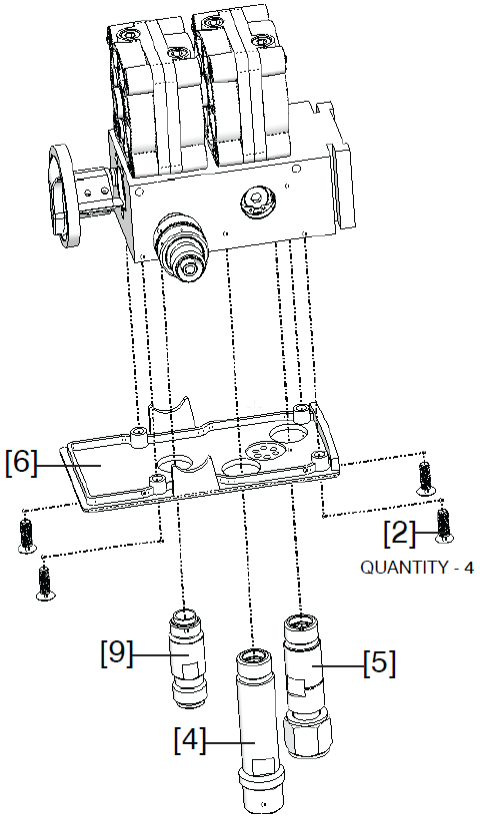


Figure C

8. Remove dial [1] by pulling dial away from manifold block [8].
9. Remove the primary [9] and auxiliary [10] outlets (auxiliary contains Blue Muffler [38]) by using a **½** in. open end wrench to unscrew.
10. Use Retaining Ring Pliers to unscrew and remove audio alarm assembly [11] from the bottom of the manifold block.

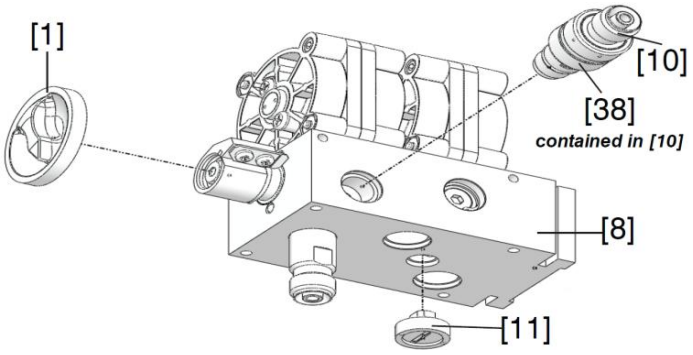


Figure D

11. Use small retaining ring pliers to remove retaining rings [12] from each side of the alarm assembly [13]. Push the alarm assembly through to remove the assembly from manifold block.

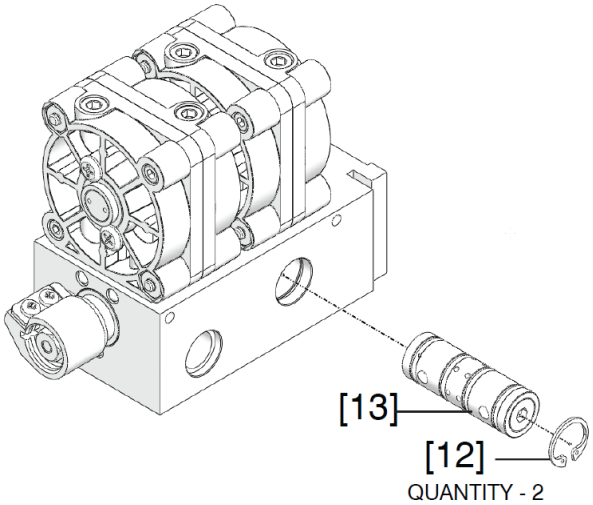


Figure E

12. Using a 11/32 in. nut driver or socket, loosen the nut [14] **(ONLY two turns)** holding the knob guide [15] on the proportioning valve assembly [16]. Slide knob guide assembly from proportioning valve assembly shaft. Slide resistance ring [17] from proportioning valve assembly.
13. Remove phillips head screw [18] and washer [19] from side of proportioning valve assembly.
14. Replace knob guide assembly and tighten the nut.
15. Pull knob guide assembly to remove proportioning valve assembly from manifold block. Again, loosen the nut **(ONLY two turns)** holding the knob guide to the proportioning valve assembly, remove knob guide from proportioning valve assembly shaft.

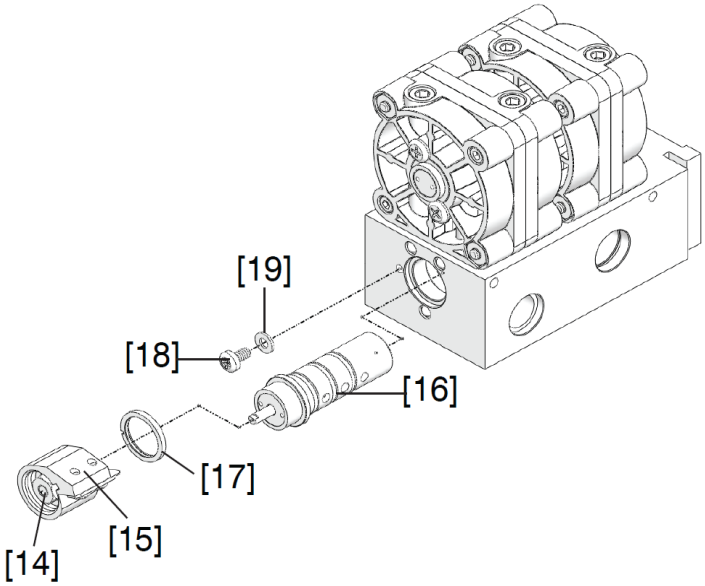


Figure F

16. Remove each diaphragm housing assembly [20] from the manifold by removing the two hex socket head screws [21] on the top of each diaphragm housing with 5/32 hex key.

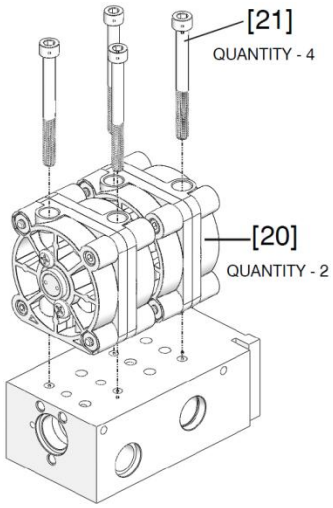
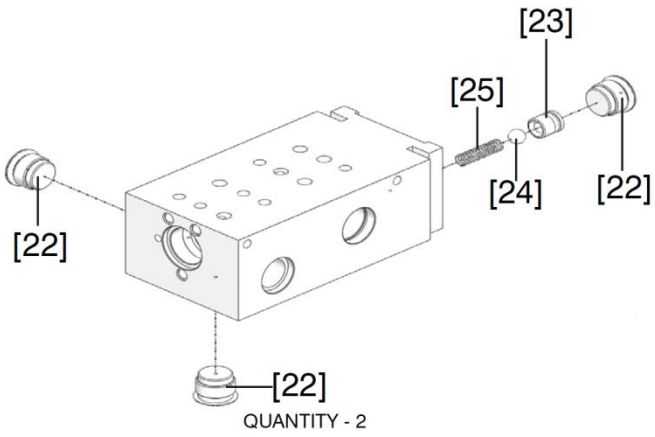


Figure G

17. Using 5/32 in. long hex wrench, unscrew and remove plug [22] from the bottom of the manifold block.
18. Remove rear plug [22] from the back of the manifold block. Insert a long 5/32 hex key through rear plug opening, unscrew and remove the alarm bypass body [23], ball [24] and spring [25].



Step 2: CLEANING

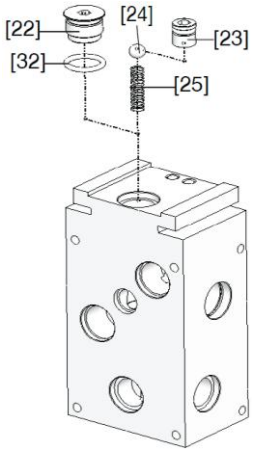
Precision Medical, Inc. recommends using an ultrasonic cleaner for cleaning all non-elastomeric and non-metallic components. However, cleaning with an all-purpose liquid cleaner and rinsing with clean, warm water may be substituted. Both methods require thoroughly blow drying all passages before reassembly. Follow the ultrasonic cleaner manufacturer instruction.

Step 3: LOW FLOW ASSEMBLY

Tools Required

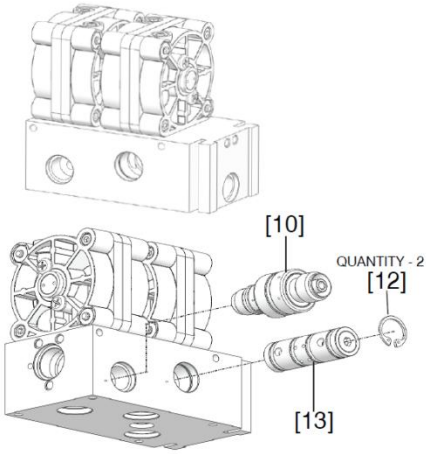
Lint Free Swab (optional)
Pointed instrument for removing O-rings
Krytox GPL 106 or equivalent
Oxygen safe lubricant
#2 Phillips Screwdriver
1/2 in. Open End Torque Wrench
(Torque wrench(s) capable of 60 in-lbs and 10 ft-lbs)
11/32 in. Nut Driver
5/32 in. Long Hex Key
Small Retaining Ring Pliers

Figure H



1. Position manifold block so that the mounting bracket is facing up. The large holes opposite the mounting locations of the diaphragm housing assemblies are facing you.
2. Cover the alarm assembly thread location with thumb. Drop spring [25] then ball [24] into alarm bypass orifice.
3. Place alarm bypass body [23] onto long shaft of 5/32 hex key. Guide the alarm bypass body, threads first into the alarm bypass orifice, and screw into cavity. Tighten until alarm bypass body is flush with bottom of center hole. **Tighten enough to clear center threads ONLY.**
4. Replace O-ring [32] on plug [22]. Insert plug and tighten.

Figure I



5. Lubricate alarm bypass assembly bore on manifold block with Krytox GPL 106.
6. Using retaining ring pliers install retaining ring [12] in one side of alarm assembly bore.
7. Insert alarm assembly [13] into bore of manifold block.
8. Install remaining retaining ring.
9. Thread auxiliary outlet assembly [10] to manifold block, torque to 10 ft-lbs (13.6 Nm).

Figure J

10. Replace O-ring [32] on plug [22]. Install plug and tighten.

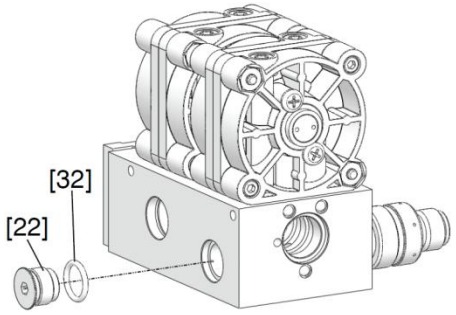


Figure K

11. Start threads of new alarm assembly [11] by hand, tighten with Retaining Ring Pliers, ensure not to bend reed.
12. Attach bottom cover [6] using four flat head screws [2].
13. Install new Heliox inlet assembly [4], torque to 10 ft-lbs (13.6 Nm).
14. Install new Oxygen inlet assembly [5] torque to 10 ft-lbs (13.6 Nm). **Oxygen inlet assembly has left handed threads.**
15. Install new Heliox inlet assembly [4], torque to 10 ft-lbs (13.6 Nm).

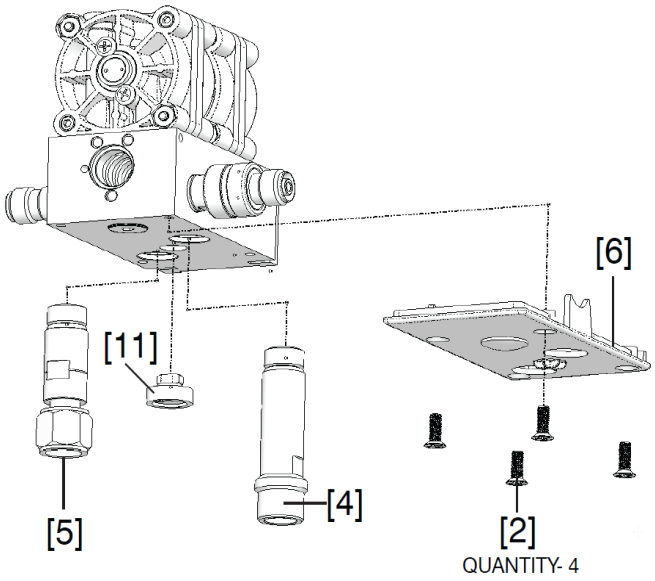
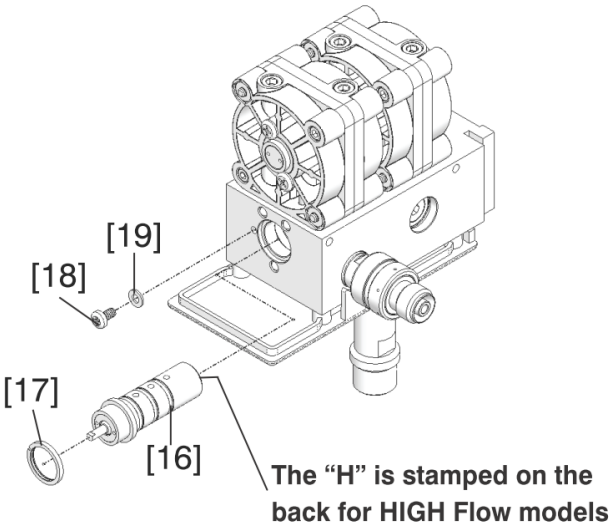
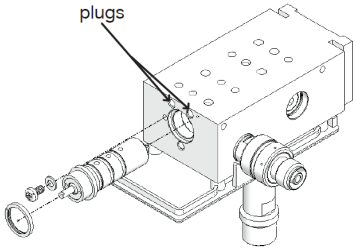


Figure L

16. Lubricate proportioning valve bore with Krytox GPL 106.
17. Align the (3) holes on the proportioning valve assembly [16] equal distance between the (2) plugs and push in. *Reference drawing below.
18. Replace washer [19] and phillips head screw [18].
19. Place new resistance ring [17] in its place on the proportioning valve assembly.
    ***Proportional valve assembly inserted, with the "H" stamped on back for High Flow Model.**





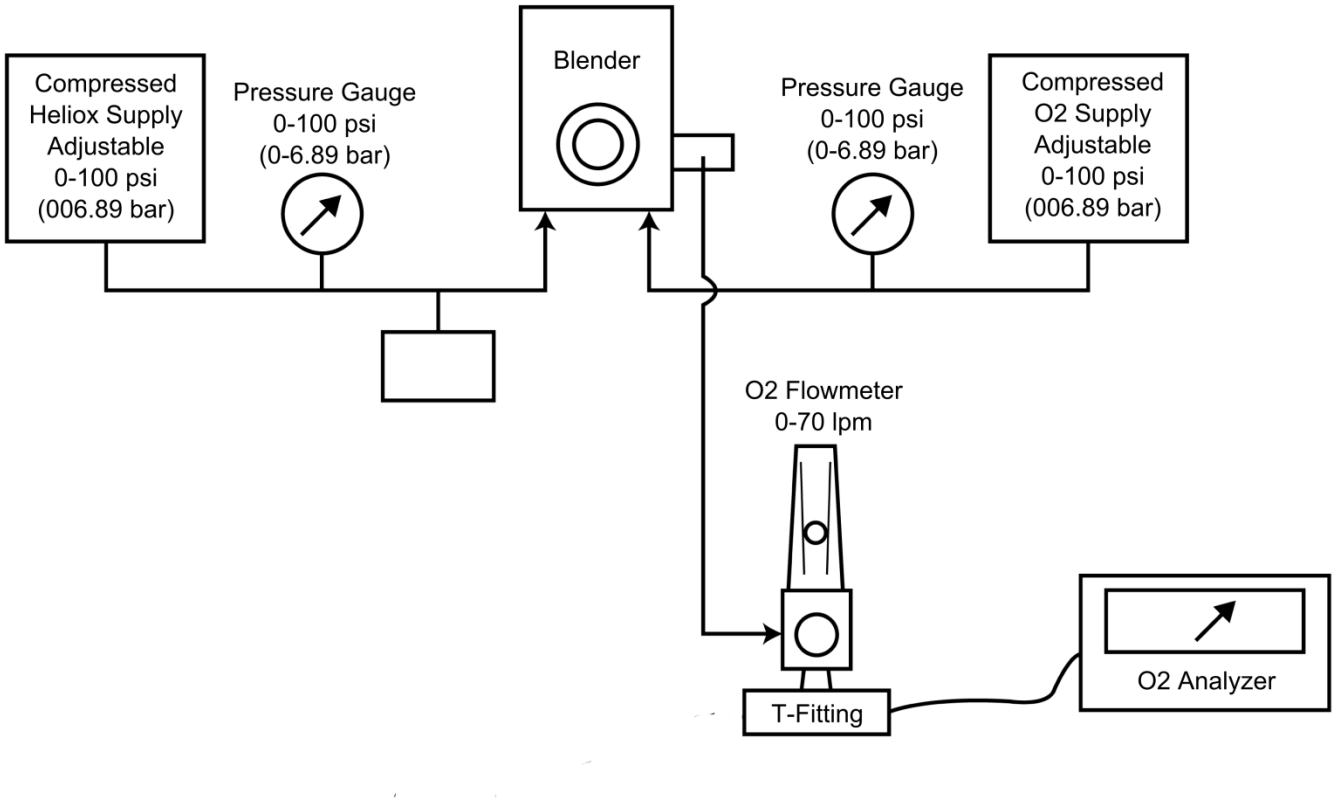
Equipment Required

Medical Heliox Supply
Medical Oxygen Supply
Calibrated Oxygen Analyzer/Monitor
Calibrated Heliox or Oxygen flow monitor 0 to 120 lpm or greater
Flowmeter 0 to 120 lpm or greater
Calibrated Pressure Gauges 0 to 100 psi
Regulators Tubing / Hoses

Tools Required

Phillips Screwdriver
Torque Driver capable of 10 in-lbs
Adjustable Wrench
Retaining Ring Pliers
Nut Driver

Typical Test Configuration Diagram


Compressed Heliox Supply Adjustable 0-100 psi (006.89 bar)
Pressure Gauge 0-100 psi (0-6.89 bar)
Blender
Pressure Gauge 0-100 psi (0-6.89 bar)
Compressed O2 Supply Adjustable 0-100 psi (006.89 bar)
O2 Flowmeter 0-70 lpm
T-Fitting
O2 Analyzer

Instructions for Testing

A. Heliox and Oxygen Supply Setup

Both gas supplies must be clean and dry per the specifications outlined in this manual and have the ability to generate up to 100 psi (6.89 bar) for both the Heliox and Oxygen inlet pressures. Verify Heliox and Oxygen supply concentrations with an analyzer/monitor.

B. Blender Setup

1. Mount the Blender into a secured mating wall or pole bracket in an upright position.
2. Secure the Heliox and Oxygen hoses to the corresponding Blender inlets.
3. It is recommended that a condensation trap be installed in the Heliox supply line just before the Blender Heliox inlet.
4. Attach a flowmeter capable of 0-120 lpm to the auxiliary outlet on the Blender.
5. Attach a t-fitting to the outlet of the flowmeter.
6. Attach an Oxygen Analyzer/Monitor to the one outlet on the t-fitting.
7. Attach a calibrated Heliox or Oxygen Flow Monitor capable of 0-120 lpm or greater to the other outlet on the t-fitting.
8. The system is now ready for an initial performance test.

C. Initial Performance Test

NOTE: Before pressurizing make sure proportioning valve assembly is secure and screw is tightened.

1. Perform calibration on Oxygen Analyzer/Monitor per the manufacturer's instructions prior to testing the Blender.
2. Set Heliox & Oxygen pressures to 50 psi (3.45 bar) each.
   NOTE: Turn OFF and check for leak by watching for pressure drops on pressure gauges.
3. An initial pressure drop may occur, no further drop in pressure should occur.
4. If continued pressure drop is observed, troubleshoot by using a commercial leak detector to find source of leak and refer to Section 4: TROUBLESHOOTING for further instructions.
5. Use a lint free dry cloth to wipe Blender clean of commercial leak detector.
6. Ensure both inlet pressures are at 50 psi.
7. Replace the top cover.
   NOTE: DO NOT install the (4) mounting screws until the end of the Final Test, or after satisfactory completion of the Performance Check. Refer to the "OPERATING INSTRUCTIONS" in Users Manual.
8. Set flowmeter to 3-3.5 lpm.
9. Set the Blender to 60% F_{IO_2} with Oxygen Analyzer/Monitor, this value should remain within 3.0% of original reading throughout the following test.
   a. Set flowmeter to 30-30.5 lpm, check concentration reading.
   b. Set flowmeter back to 3-3.5 lpm.
   c. Set Heliox inlet pressure to 50 psi (3.45 bar) and the Oxygen inlet pressure to 43 psi (2.96 bar) adjust flow to 3-3.5 lpm, check concentration reading.
   d. Set Heliox inlet pressure to 43 psi (2.96 bar) and the Oxygen inlet pressure to 50 psi (3.45 bar) adjust flow to 3-3.5 lpm, check concentration reading.
   e. If the Oxygen Analyzer/Monitor setting does not remain within 3.0% of the original reading, then replace one or both of the diaphragm block assemblies.

D. Reverse Gas Flow Procedure

(Reference Operational Verification Procedure #'s 2 & 3 in Table, page 24 or 25)

1. Disconnect the Oxygen hose from the gas source. Remove all outlet connections from the Blender to ensure that there is no outlet flow.
2. Place the free end of the Oxygen supply hose under water. Gradually increase the Heliox supply pressure from 30 - 75 psi (2.07 - 5.17 bar), check for leakage past the Oxygen inlet check valve.
3. Replace the Duckbill Check Valve in the Oxygen inlet if bubbles indicate leakage.
4. Repeat steps 1-3 to check for leakage past the Heliox inlet check valve.
5. Reconnect the Heliox inlet hose and adjust both supply pressures back to standard inlet pressure.

E. Setup of PROPORTIONING VALVE ASSEMBLY CALIBRATION

1. Set Heliox and Oxygen inlet pressures to 50 psi.
2. Set flow to 9 lpm.
3. Turn Adjustment Shaft counterclockwise until the Oxygen Analyzer/Monitor displays a concentration equal to that of the source Heliox (±0.3), reference Part A in Setup.
4. Attach knob guide assembly onto adjustment shaft of proportioning valve assembly so that the knob stop rests on top of the screw. Ensure knob stop aligns with the slot in the resistance ring.
5. While applying downward pressure to the 2 screws on the knob guide assembly, attach nut to adjustment shaft using nut driver.
6. Turn knob guide fully clockwise, Oxygen Analyzer/Monitor display should be equal to concentration of the source Oxygen (±0.3).
7. Turn knob guide back to 21% position to ensure no drift from original reading (±0.3).
8. Re-attach knob guide, torque nut to adjustment shaft and tighten to 10 in-lbs using a torque driver.
9. Snap in knob back into knob guide, pay close attention to the key location of the knob.
10. Set knob to 60 graduation.
11. Replace the top cover.

    NOTE: DO NOT install the four (4) mounting screws until the end of the Final Test.

F. Final Test

Complete Operation Verification Procedure as per the test table, page 24 or 25.

Record test results in the test table.

When Final Test is complete replace top cover and install the four (4) mounting screws into cover.

NOTE: Operation Verification Procedure should be performed at least once a year.

High Flow Operation Verification Procedure

USA and CANADA ONLY

(50 psi / 3.45 bar MODELS)

S E Q #	DIAL SET O2%	OXYGEN PRESS ±1.0		HELIOX PRESS ±1.0		FLOWMETER SET TO lpm ±0.2	AUXILIARY BLEED	FUNCTION	TARGET VALUE	ACTUAL VALUE
		psi	bar	psi	bar					
1	ANY	50	3.45	50	3.45	closed	closed	leak	<2 psi / 2 MIN	
***2**	60	75	5.17	0	0	0	closed	back flow	<100 ml/min	
***3**	60	0	0	75	5.17	0	closed	back flow	<100 ml/min	
4	21	50	3.45	50	3.45	3	open	end point	(±0.3) Source Value	
5	40	50	3.45	50	3.45	3	open	set point	37.0%-43.0%	
6	60	50	3.45	50	3.45	3	open	set point	57.0%-63.0%	
7	80	50	3.45	50	3.45	3	open	set point	77.0%-83.0%	
8	100	50	3.45	50	3.45	3	open	end point	(±0.3) Source Value	
9	60	50	3.45	50	3.45	1	open	set point	57.0%-63.0%	
10	60	60	4.14	67	4.62	1	open	set point	57.0%-63.0%	
11	60	60	4.14	50	3.45	1	open	set point	57.0%-63.0%	
12	60	50	3.45	Slowly reduce to 31	Slowly reduce to 2.14	3	closed	Alarm ON	31.0 ± 6.0 psi	
13	60	50	3.45	Slowly Increase until alarm shuts off		3	closed	Alarm OFF	45.0 psi MAX	
14	60	Slowly Reduce to 31	Slowly Reduce to 2.14	50	3.45	3	closed	Alarm ON	31.0 ± 6.0 psi	
15	60	Slowly Increase until alarm shuts off		50	3.45	3	closed	Alarm OFF	45.0 psi MAX	
16	60	50	3.45	50	3.45	MAX	closed	flow rate	120.0 lpm MIN	
17	60	50	3.45	0		MAX	closed	flow rate	85.0 lpm MIN	
18	60	0		50	3.45	MAX	closed	flow rate	85.0 lpm MIN	
19	60	50	3.45	50	3.45	MAX	open	flow rate	120.0 lpm MIN	

* Reference, Letter D. (Reverse Gas Flow Procedure)

III. INTERNATIONAL LOW / HIGH Flow Operation Verification Procedure

(60 psi / 4.14 bar MODELS)

S E Q #	DIAL SET O2%	OXYGEN PRESS ±1.0		HELIOX PRESS ±1.0		FLOWMETER SET TO lpm ±0.2		AUXILIARY BLEED		FUNCTION	TARGET VALUE		ACTUAL VALUE
		psi	bar	psi	bar	Low Flow	High Flow	Low Flow	High Flow		Low Flow	High Flow	
1	ANY	60	4.14	60	4.14	closed		closed		leak	<2 psi / 2 MIN		
***2**	60	75	5.17	0	0	0		closed		back flow	<100 ml/min		
***3**	60	0	0	75	5.17	0		closed		back flow	<100 ml/min		
4	21	60	4.14	60	4.14	3	15	open	closed	end point	(±0.3) Source Value		
5	40	60	4.14	60	3.45	3	15	open	closed	set point	37.0%-43.0%		
6	60	60	4.14	60	3.45	3	15	open	closed	set point	57.0%-63.0%		
7	80	60	4.14	60	3.45	3	15	open	closed	set point	77.0%-83.0%		
8	100	60	4.14	60	3.45	3	15	open	closed	end point	(±0.3) Source Value		
9	60	60	4.14	60	3.45	1	1.5	open		set point	57.0%-63.0%		
10	60	60	4.14	70	4.83	1	1.5	open		set point	57.0%-63.0%		
11	60	60	4.14	53	3.65	1	1.5	open		set point	57.0%-63.0%		
12	60	60	4.14	Slowly reduce to 40	Slowly reduce to 2.76	3	15	closed		Alarm ON	42.0 ± 2.0 psi	31.0 ± 6.0 psi	
13	60	60	4.14	Slowly Increase to 60	Slowly Increase to 4.14	3	15	closed		Alarm OFF	45.0 psi MAX		
14	60	Slowly Reduce to 40	Slowly Reduce to 2.76	60	4.14	3	15	closed		Alarm ON	42.0 ± 2.0 psi	31.0 ± 6.0 psi	
15	60	Slowly Increase to 60	Slowly Increase to 4.14	60	4.14	3	15	closed		Alarm OFF	55.0 psi MAX		
16	60	60	4.14	60	4.14	MAX		closed		flow rate	30.0 lpm MIN	120.0 lpm MIN	
17	60	60	4.14	0		MAX		closed		flow rate	30.0 lpm MIN	85.0 lpm MIN	
18	60	0		60	4.14	MAX		closed		flow rate	30.0 lpm MIN	85.0 lpm MIN	
19	60	60	4.14	60	4.14	MAX		open		flow rate	30.0 lpm MIN	120.0 lpm MIN	

* Reference, Letter D. (Reverse Gas Flow Procedure)

SECTION 4: TROUBLESHOOTING

Test #'s	Problem	Probable Cause	Remedy
1	Pressure drop greater than 2 psi in two minutes	Leakage from manifold caused by cut or missing o-ring or due to particulates.	Check ALL manifold connections (inlets, outlets, plugs, proportioning valve, alarm poppet, etc.) with Oxygen leak detector to find source of leakage; if leak is found, remove appropriate parts and clean seal area and o-rings and/or replace appropriate o-ring.
		Ball not sealing in the alarm bypass.	Replace spring and ball in alarm bypass; ensure seal surface is clean.
		Auxiliary bleed is open.	Close auxiliary bleed by turning and pulling knurled collar away from cover until bleed is closed.
		Leakage from one of the outlets.	Replace outlet.
2 and 3	Back flow leak	Faulty inlet.	Replace duckbill valve or entire inlet assembly.
4 thru 8	Measured F_{IO_2} values do not meet target values	Outlet flow is less than 3 lpm.	Adjust flowmeter to 3 lpm ***(Note:** flow must be adjusted after each change in F_{IO_2} setting)*.
		Proportioning valve endpoints are not set correctly.	Set proportioning valve endpoints *(See setup procedure in Section E)**.***
		Diaphragm blocks not balancing properly.	Replace Diaphragm Blocks.
		Internal leakage in proportion valve.	Remove proportioning valve; clean seal areas and/ or replace the two rear o-rings. If necessary, replace proportioning valve assembly.
9 thru 11	Measured F_{IO_2} values do not meet target values	Bleed not open.	Open bleed by turning and pushing the knurled collar until it contacts the cover.
		Blockage in bleed holes.	Replace auxiliary outlet.
		Internal leak in proportioning valve.	Remove proportioning valve; clean seal areas and/ or replace the two rear o-rings. If necessary, replace proportioning valve assembly.
		Flow not set to 1 lpm.	Adjust flow to 1 lpm.
		Diaphragm blocks not balancing properly.	Replace diaphragm block.
12 And 14	Alarm not audible and gas is not exiting the alarm vent	Pressure differential not sufficient to trigger alarm.	Ensure supply pressures are set properly to achieve differential (***Low Flow:*** 18 to 22; ***High Flow:*** 13 to 25).
	Alarm not audible and gas is exiting the alarm vent	Faulty alarm.	Replace alarm. ***(See Figure C & K)***
13 And 15	Alarm does not turn off after balancing supply pressures	Faulty alarm assembly.	Replace alarm assembly. ***(See Figure C & K)***
		Ball not sealing in the alarm bypass.	Replace spring and ball in alarm bypass; ensure seal surface is clean.
16 Thru 19	Measured flow values do not meet minimum target values	Gas inlets are restricted.	Check appropriate gas inlet(s) for restriction in gas pathway; replace duckbill or entire inlet as necessary.
		High flow model only: low flow inlets installed in place of high-flow inlets.	Confirm that high-flow inlets are installed; replace as necessary.
		Alarm bypass is threaded too far into manifold block *(only applicable to tests 17 and 18).*	Replace ball and spring *(see Figure I for proper assembly method).*
		High flow models only: wrong ball in alarm bypass block *(only applicable to tests 17 and 18).*	Confirm that correct ball is installed in alarm bypass; replace as necessary.

SECTION 5: BLENDER PARTS LIST

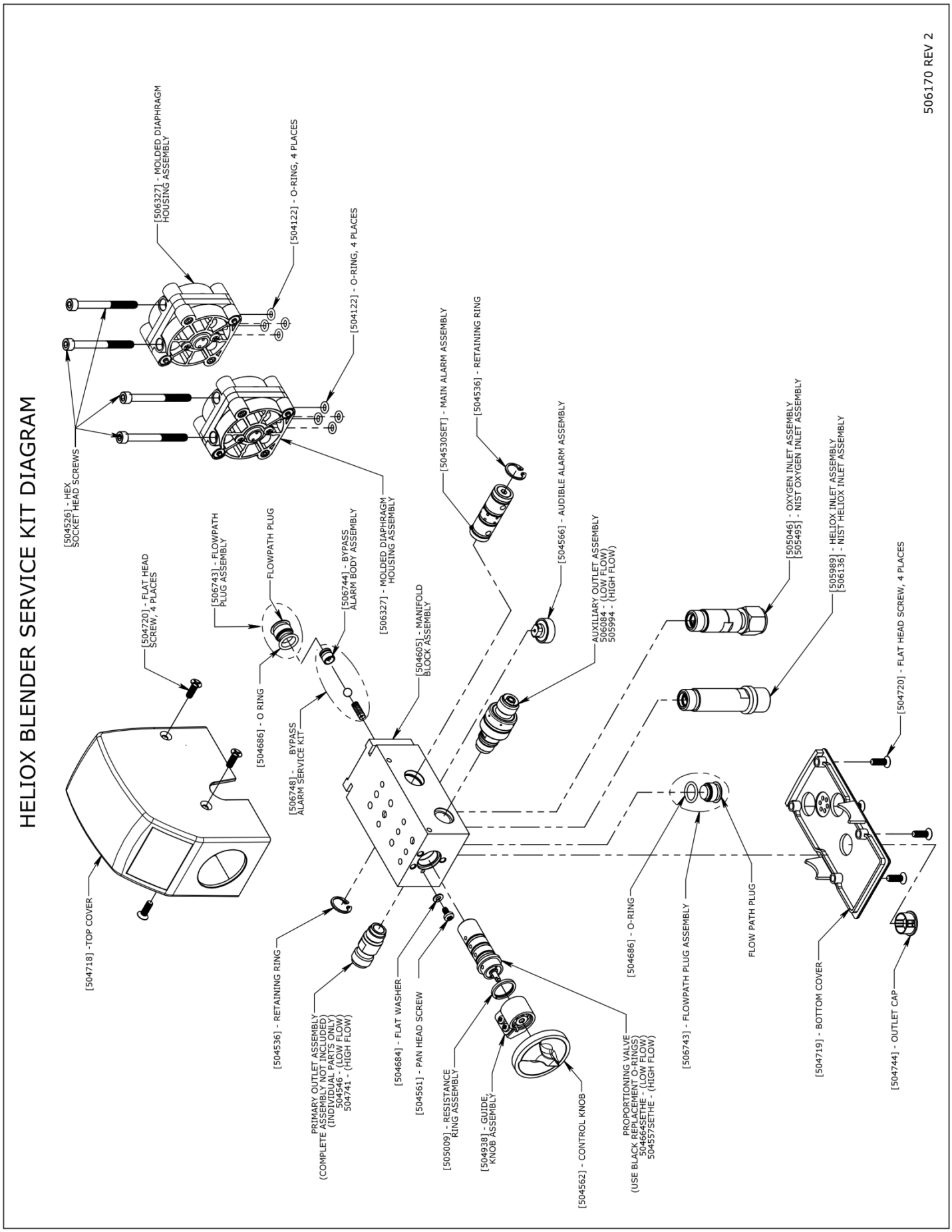
Reference Diagram on page 29

PART #	DESCRIPTION	LOW FLOW *PM5400*	HIGH FLOW *PM5500*
504562	CONTROL KNOB (Dial)	☒	☒
504720	FLAT HEAD SCREW	☒	☒
504718	TOP COVER	☒	☒
504719	BOTTOM COVER	☒	☒
505989	HELIOX INLET ASSEMBLY	☒	☒
505046	OXYGEN INLET ASSEMBLY	☒	☒
504605	MANIFOLD BLOCK ASSEMBLY	☒	☒
504546	PRIMARY OUTLET ASSEMBLY	☒	
504741			☒
506084	EASYOFF AUXILIARY ASSEMBLY	☒	
505994			☒
504566	AUDIO ALARM ASSEMBLY	☒	☒
504536	RING RETAINING	☒	☒
504530 set	MAIN ALARM ASSEMBLY	☒	☒
504938	GUIDE KNOB ASSEMBLY	☒	☒
504664 set HE	PROPORTIONING VALVE ASSEMBLY	☒	
504557 set HE			☒
505009	RESISTANCE RING	☒	☒
504561	PAN HEAD SCREW	☒	☒
504684	FLAT WASHER	☒	☒
506327	MOLDED DIAPHRAGM HOUSING ASSEMBLY	☒	☒
504526	HEX SOCKET HEAD SCREW	☒	☒
506748	BYPASS ALARM SERVICE KIT	☒	☒
504122	O-RING, #008,SILICONE,70 DUROMETER	☒	☒
504686	O-RING, #013,SILICONE,70 DUROMETER	☒	☒
504744	OUTLET CAP	☒	☒
506743	FLOW PATH PLUG ASSEMBLY	☒	☒
506744	BYPASS ALARM BODY ASSEMBLY (Included in 506748 and 506745: Bypass Alarm Service Kit)	☒	☒
506212	SERVICE KIT		☒
506125		☒	

NIST BLENDERS ONLY			
506864	SERVICE KIT - PM5500NIST		☒
506863	SERVICE KIT - PM5400NIST	☒	
506136	NIST HELIOX INLET ASSEMBLY	☒	☒
505495	NIST OXYGEN INLET ASSEMBLY	☒	☒

Label information

Part #	Label Description	Low Flow PM5400	High Flow PM5500	Location (Blender / dial facing you)
506122	Primary Outlet		☒	Left Side on top cover
606019		☒		
506008	Side Labels	☒		Left & Right Side on top cover
506013			☒	
505961	Scale 20-100		☒	Bottom Front on top cover
505960		☒		
505974	Scale 30-100		☒	Bottom Front on top cover
505973		☒		
506004	Face	☒	☒	Top Front on top cover
506003	Auxiliary Outlet		☒	Right Side on top cover
506020		☒		
506018	Bottom	☒	☒	Bottom Cover
507043	Warning, Inlet Pressure	☒	☒	Top Back of top cover
504879	Year of Mfg / CE	☒	☒	Bottom Back of top cover Under Model#, Caution Label (CE Models Only)


HELIOX BLENDER SERVICE KIT DIAGRAM
506170 REV 2
[504526] - HEX SOCKET HEAD SCREWS
[506327] - MOLDED DIAPHRAGM HOUSING ASSEMBLY
[504122] - O-RING, 4 PLACES
[504122] - O-RING, 4 PLACES
[504530SET] - MAIN ALARM ASSEMBLY
[504536] - RETAINING RING
[504566] - AUDIBLE ALARM ASSEMBLY
AUXILIARY OUTLET ASSEMBLY
506084 - (LOW FLOW)
505994 - (HIGH FLOW)
[505046] - OXYGEN INLET ASSEMBLY
[505495] - NIST OXYGEN INLET ASSEMBLY
[505989] - HELIOX INLET ASSEMBLY
[506136] - NIST HELIOX INLET ASSEMBLY
[504720] - FLAT HEAD SCREW, 4 PLACES
[504719] - BOTTOM COVER
[504744] - OUTLET CAP
[504718] -TOP COVER
[504720] - FLAT HEAD SCREW, 4 PLACES
[506743] - FLOWPATH PLUG ASSEMBLY
FLOWPATH PLUG
[504686] - O RING
[506748] - BYPASS ALARM SERVICE KIT
[506744] - BYPASS ALARM BODY ASSEMBLY
[506327] - MOLDED DIAPHRAGM HOUSING ASSEMBLY
[504605] - MANIFOLD BLOCK ASSEMBLY
[504536] - RETAINING RING
PRIMARY OUTLET ASSEMBLY
(COMPLETE ASSEMBLY NOT INCLUDED)
(INDIVIDUAL PARTS ONLY)
504546 - (LOW FLOW)
504741 - (HIGH FLOW)
[504684] - FLAT WASHER
[504561] - PAN HEAD SCREW
[505009] - RESISTANCE RING ASSEMBLY
[504938] - GUIDE, KNOB ASSEMBLY
[504562] - CONTROL KNOB
PROPORTIONING VALVE
(USE BLACK REPLACEMENT O-RINGS)
504664SETHE - (LOW FLOW)
504557SETHE - (HIGH FLOW)
[504686] - O-RING
[506743] - FLOWPATH PLUG ASSEMBLY
FLOW PATH PLUG

Precision Medical, Inc.
300 Held Drive
Northampton, Pa 18067 USA

Toll Free Tel: 800-272-7285
Toll Free Fax: 800-353-1240
Tel:(+001) 610-262-6090
Fax:(+001) 610-262-6080